

CLAIMS

- [c1] 1. A superconducting magnet electrical circuit comprising:
- (a) a superconducting coil assemblage including a plurality of spatially separated main magnet coil portions connected in series to form at least one main coil series circuit and a plurality of spatially separated secondary magnet coil portions connected in series to form at least one secondary coil series circuit;
 - (b) at least one temperature limiting circuit connected with the superconducting coil assemblage selected from the group consisting of a quench heater circuit or a quench resistor circuit; and
 - (c) a superconductive switch coupled with the superconducting coil assemblage.
- [c2] 2. The superconducting magnet electrical circuit according to claim 1 wherein said coil portions are essentially completely in contact with a fluid cryogen.
- [c3] 3. The superconducting magnet electrical circuit according to claim 1 wherein the superconducting coil assemblage has at least two main magnet coil portions connected in series to form the main coil series circuit.
- [c4] 4. The superconducting magnet electrical circuit according to claim 1 wherein the superconducting coil assemblage has at least two secondary magnet coil portions connected in series to form the secondary coil series circuit.
- [c5] 5. The superconducting magnet electrical circuit according to claim 1 wherein the secondary magnet coil portions carry current in an opposite direction to the main magnet coil portions.
- [c6] 6. The superconducting magnet electrical circuit according to claim 1 wherein the secondary magnet coil portions form a shielding coil positioned to prevent stray magnetic fields from escaping the magnet assembly.
- [c7] 7. A superconducting magnet electrical circuit comprising:
- (a) a superconducting coil assemblage including a plurality of spatially separated main magnet coil portions connected in series to form at least one main coil series circuit and a plurality of spatially separated secondary magnet coil portions connected in series to form at least one secondary coil series circuit;
 - (b) at least one quench heater circuit with a plurality of quench heaters connected in

parallel with the superconducting coil assemblage; and

(c) a superconductive switch coupled with the superconducting coil assemblage.

[c8] 8. The superconducting magnet electrical circuit according to claim 7 wherein at least one quench heater is positioned in thermal contact with the main magnet coil portions and at least one quench heater is positioned in thermal contact with the secondary magnet coil portions.

[c9] 9. The superconducting magnet electrical circuit according to claim 7 wherein the number of said heaters connected in parallel with each of said separated main magnet coil portions is at least equal to the number of said main magnet coil portions being protected.

[c10] 10. The superconducting magnet electrical circuit according to claim 7 comprising at least two quench heater circuits.

[c11] 11. The superconducting magnet electrical circuit according to claim 10 wherein each quench heater circuit comprises at least two quench heaters.

[c12] 12. A superconducting magnet electrical circuit comprising:
(a) a superconducting coil assemblage including a plurality of spatially separated main magnet coil portions connected in series to form at least one main coil series circuit and a plurality of spatially separated secondary magnet coil portions connected in series to form at least one secondary coil series circuit;
(b) at least one quench resistor circuit connected in parallel with the superconducting coil assemblage, said quench resistor circuit having a plurality of quench resistors connected in series or in parallel with each other; and
(c) a superconductive switch coupled with the superconducting coil assemblage.

[c13] 13. A superconducting magnet electrical circuit comprising:
(a) a superconducting coil assemblage including a plurality of spatially separated main magnet coil portions connected in series to form at least one main coil series circuit and a plurality of spatially separated secondary magnet coil portions connected in series to form at least one secondary series circuit;
(b) at least one quench heater circuit with a plurality of generally identical quench heaters connected in parallel with the superconducting coil assemblage;
(c) at least one quench resistor circuit connected in parallel with the superconducting coil

assembly, said quench resistor circuit having a plurality of generally identical quench resistors connected in series or in parallel with each other; and
(d) a superconductive switch coupled with the superconducting coil assembly.

[c14]

14. A superconducting magnet electrical circuit comprising:

- (a) a superconducting coil assembly including at least two spatially separated main magnet coils connected in series to form at least one main coil series circuit and at least two spatially separated secondary magnet coils connected in series to form at least one secondary coil series circuit, said coils being essentially completely in contact with a fluid cryogen;
- (b) at least one temperature limiting circuit connected in parallel with the superconducting coil assembly, said temperature limiting circuit selected from a first group consisting of a quench heater circuit comprising a plurality of quench heaters connected in parallel, and a quench resistor circuit comprising a plurality of quench resistors connected in parallel or in series; and
- (c) a superconductive switch coupled with the superconducting coil assembly.

[c15]

15. A superconducting magnet electrical circuit comprising:

- (a) a superconducting coil assembly including at least two spatially separated main magnet coils connected in series to form at least one main coil series circuit and at least two spatially separated secondary magnet coils connected in series to form at least one secondary coil series circuit, said coils being essentially completely in contact with a fluid cryogen;
- (b) at least one quench heater circuit with a plurality of quench heaters connected in parallel with the superconducting coil assembly wherein at least one quench heater is positioned in thermal contact with the main coil portion and at least one quench heater is positioned in thermal contact with the secondary magnet coil portion; and
- (c) a superconductive switch coupled with the superconducting assembly.

[c16]

16. A superconductive magnet electrical circuit comprising:

- (a) a superconducting coil assembly including at least two spatially separated main magnet coils connected in series to form at least one main magnet coil series circuit and at least two spatially separated secondary magnet coils connected in series to form at least one secondary coil series circuit, said coils being essentially completely in contact with a fluid cryogen;

